cFS-based Autonomous Requirements Testing Tool, Phase I Project

SBIR/STTR Programs | Space Technology Mission Directorate (STMD)

ABSTRACT

The S&K Team proposes design of a tool suite, Autonomy Requirements Tester (ART), to address the difficulty of stating autonomous requirements and the links to clear testing plans. ART will represent autonomy requirements, test plans, and test results, and the relationships among them so that it is less difficult to state autonomy requirements clearly, to communicate test plans clearly among the full development team, to guide software development from requirements through acceptance tests, and to communicate test results in terms of the completeness with which the requirements have been tested. This will extend the state of the art by clarifying the progression from autonomy requirements to test results and make the tests more modular and reusable. The S&K team will first identify representative autonomy requirements for a design reference mission and high-level descriptions of how to test those requirements in the developed system. The team will then design XML schemas to represent data structures that define autonomy requirements, related test objectives, related cFS messages, test specifications and results. Next, they identify ways to generate and execute those tests by publishing and subscribing to appropriate cFS messages to run tests and examine the results. The S&K team will design information displays for showing relationship among requirements, test designs and results so that it is clear how thoroughly the autonomy requirements have been tested and how they performed. The team will develop a concept of operations for ART. They will prototype enough of the concept to demonstrate the feasibility of the approach, write a final report, and deliver results along with submission of a Phase II proposal.

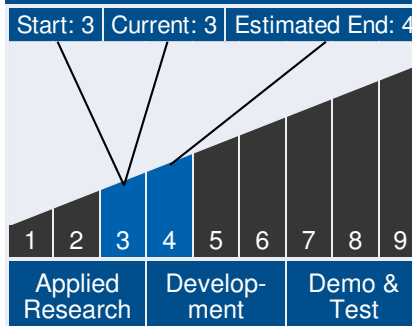## ANTICIPATED BENEFITS

To NASA funded missions:

Potential NASA Commercial Applications: ART will assist engineers and project engineers at NASA in managing and

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Technology Maturity

Start: 3 | Current: 3 | Estimated End: 4

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |

| Applied Research | Develop-ment | Demo & Test |

Management Team

Program Executives:
- Joseph Grant
- Laguduva Kubendran

Program Manager:
- Carlos Torrez

Continued on following page.

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communicating autonomy requirements for flight and robotic systems. The forecasted potential and targeted applications relative to NASA needs are the development of robots (especially those interacting with humans) and the development of autonomous spacecraft systems both for unmanned spacecraft and those supporting small crews that operate at long distances from earth with resulting communications delays. The potential customers include manned missions to Mars and unmanned missions that will require increasing autonomy. They also include the development of robots like Valkyrie and Robonaut 2 that will support a small crew in performing safely the numerous duties required to operate a spacecraft for long duration, long distance missions. As pressures increase for spacecraft autonomy, the complexity of the autonomy and the number of systems that involve autonomy will increase. ART offers the ability to develop and test autonomy requirements more cost effectively.

To the commercial space industry:

Potential Non-NASA Commercial Applications: There are a number of non-NASA applications that could benefit from better management of requirements for autonomy. In the developing drone market, there is already a very strong push for operating drones beyond the operator's line of sight, which requires autonomy to ensure successful completion of drone sorties. Autonomy is appearing with greater frequency and complexity in all sorts of software from office automation to data base searches and web site and smart phone applications. As these services expand their autonomy, they will feel greater pressure in managing the development and testing of that autonomy so that they can develop it efficiently and communicate it clearly to their customers. The S&K Team will need to perform market analyses in the future to determine if it is better to pursue a very simple application that can be started and used with very little training or a more detailed that can help to manage efforts of hundreds of engineers. Perhaps the best option is to offer both a light and a heavy duty version, with the light version getting
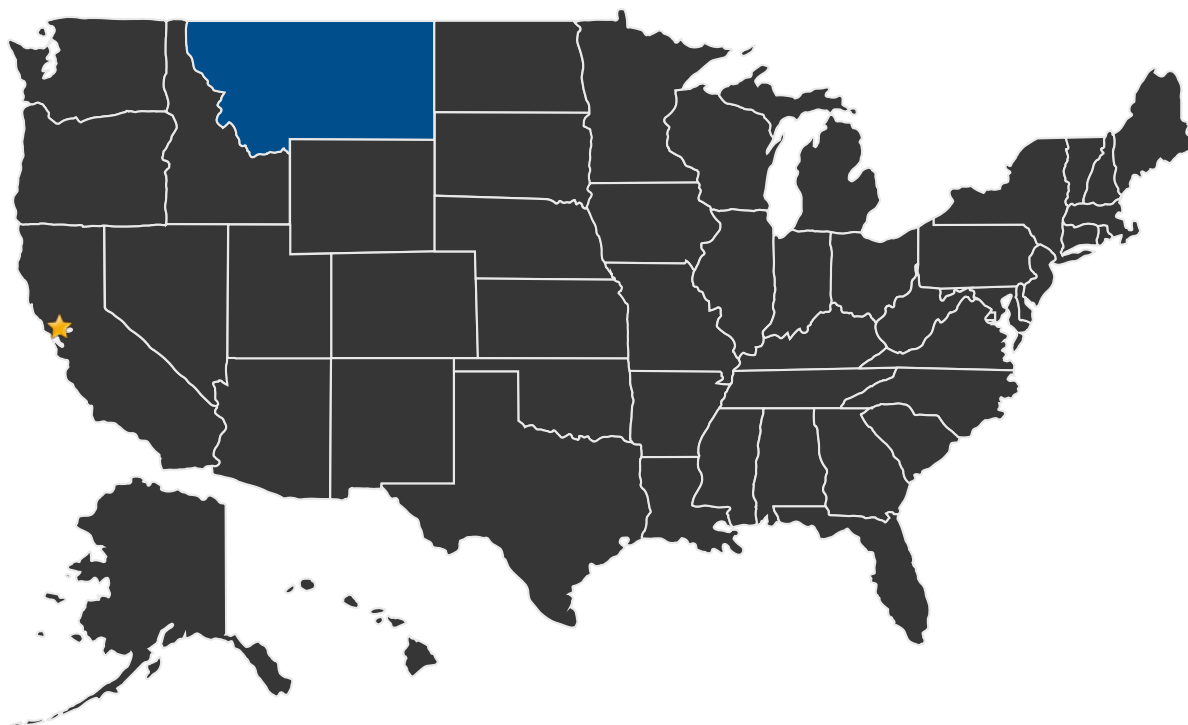
Management Team *(cont.)*

Principal Investigator:
- Carroll Thronesbery

potential customers into the framework of thinking about FM using our approach and the heavy duty assisting the coordination of a large number of engineers.

U.S. WORK LOCATIONS AND KEY PARTNERS

■ U.S. States With Work   ⭐ **Lead Center:**
                                  Ames Research Center

Other Organizations Performing Work:

- S&K Global Solutions, LLC (Polson, MT)
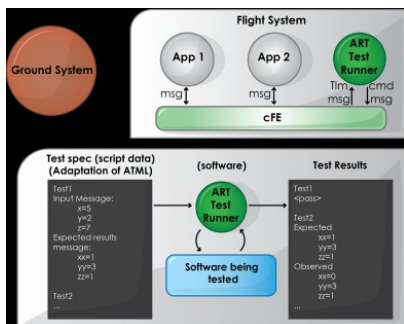
PROJECT LIBRARY

Presentations

- Briefing Chart
   - (http://techport.nasa.gov:80/file/23241)

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IMAGE GALLERY

cFS-based Autonomous Requirements Testing Tool, Phase I

DETAILS FOR TECHNOLOGY 1

Technology Title

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Potential Applications

ART will assist engineers and project engineers at NASA in managing and communicating autonomy requirements for flight and robotic systems. The forecasted potential and targeted applications relative to NASA needs are the development of robots (especially those interacting with humans) and the development of autonomous spacecraft systems both for unmanned spacecraft and those supporting small crews that operate at long distances from earth with resulting communications delays. The potential customers include manned missions to Mars and unmanned missions that will require increasing autonomy. They also include the development of robots like Valkyrie and Robonaut 2 that will support a small crew in performing safely the numerous duties required to operate a spacecraft for long duration, long distance missions. As pressures increase for spacecraft autonomy, the complexity of the autonomy and the number of systems that involve autonomy will increase. ART offers the ability to develop and test autonomy requirements more cost effectively.